INVENTIONS & INNOVATION

Success Story

HIGH-EFFICIENCY DIRECT-CONTACT WATER HEATER

Benefits

- Often eliminates the boiler, thereby saving labor costs and avoiding the need to buy insurance for a high-pressure system, to conduct annual inspections, and to buy boiler treatments and chemicals
- Provides instant hot water at precise temperature control to avoid overheating and resulting excess energy usage
- Has saved 340 trillion Btu through 2000, saving users over $1 billion in natural gas purchases
- Has reduced CO_2 emissions by 20 million tons through 2000 because of reduced natural gas usage

Applications

- Kemco water heating systems have proven their effectiveness in many applications, including commercial laundries and manufacturing plants for concrete, textiles, food processing, leather, chemicals, and automobiles.
- A Kemco unit that replaced steam boilers at the Ford Motor Company's automotive assembly plant in Edison, New Jersey, saves about $400,000 annually.

System Saves Energy and Reduces Operating Costs

Industrial water heating accounts for a large portion of energy use in industries such as concrete production, textiles, food processing, tanning, and commercial laundries, which use huge volumes of hot water for cleaning, washing, and sterilizing applications. These industries have turned to high-efficiency direct-contact water heaters to improve productivity and reduce energy costs.

Through a grant from the U.S. Department of Energy's Inventions and Innovation Program (formerly the Energy Related Inventions Program), inventor Harry E. Wood conducted the first field evaluation of the direct-contact water heater in the late 1970s. Based on this field experience, Mr. Wood obtained a patent for the ideal heat transfer system for commercial and industrial water heating. Kemco Systems, Inc., purchased the patent from Mr. Wood in 1980 and further developed the water heating system. Kemco's system uses a water-cooled burner sleeve and combustion zone to extract all possible energy from natural gas combustion by bringing water into direct contact with a submerged-flame jet-type burner.

Direct–Contact, Gas–Fired Hot Water Heater Saves Money and Energy

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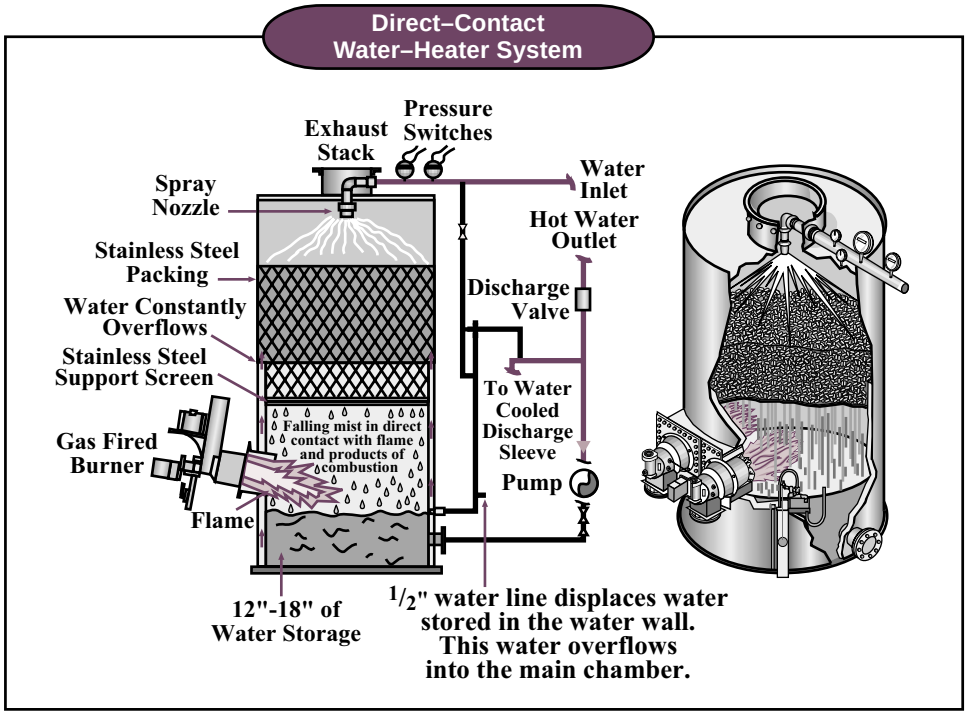
Project Description

Kemco purchased the patent from Mr. Wood to manufacture direct-contact water heating technology as the Thermefficient-100. After 20 years, Kemco accounts for the majority of true direct-contact water heating sales.

Approximately 3,000 Kemco installations are operating in the United States and worldwide. As the schematic below shows, a nozzle mounted on top of the cylindrical, nonpressurized water vessel sprays water into the vessel, and the water cascades over a gas-fired low-NO_x burner. The water is instantly heated as it falls through the heat transfer zone and flame, supplying hot water within seconds. The water collects in the bottom of the tank and is pumped to the storage tank or load.

Kemco's product line of direct-contact water heaters offers efficiencies up to 99.7% compared with the 60% to 75% efficiency of a conventional water heating system.



Capabilities

- Provides almost instantaneous water heating.
- Provides flow rates from 10 to 500 gallons/minute.
- Available in 1.2 million to 37 million Btu/hour capacities.

Awards

In September 1999, *Food Processing* magazine gave Kemco's direct-contact hot water system an Achievement Award in the Processing Technology category. Entries were judged on various criteria, including innovation, contribution to productivity and cost reduction, and significance to the food industry.

OFFICE OF INDUSTRIAL TECHNOLOGIES

ENERGY EFFICIENCY AND
RENEWABLE ENERGY
U.S. DEPARTMENT OF ENERGY

"Kemco is the market leader for direct-contact water heating, and the I&I grant initiated this leadership by proving that direct-contact water heating does not impact water purity."

– Ed Rodriguez
Kemco Systems, Inc.

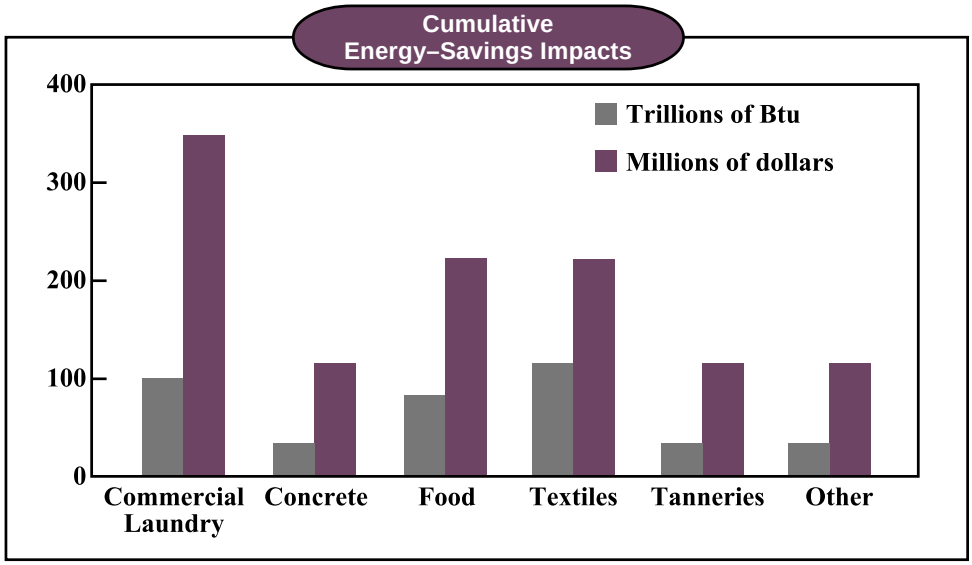
Calculated Energy Savings (through 2000)

Total operating hours	10 hour/day for 250 days/year
Direct–contact water heater *(99.7% efficient)*	12 million Btu/hour
Conventional boiler *(70% efficient)*	17 million Btu/hour
Daily savings	50 million Btu/day
Annual savings per unit	>12 billion Btu/year
Annual energy cost	$6.70 per million Btu
Annual energy savings *(1 unit)*	~$85,000

Energy Savings and Pollution Prevention

The table above shows that a 12 million Btu/hr Kemco unit saves 50 million Btu each day compared with a conventional water heating system. Approximately 3,000 Kemco systems with this capacity will save 38 trillion Btu per year. The total cumulative energy savings from Kemco systems are over 340 trillion Btu through 2000, making high-efficiency water heaters the top energy-savings investment for the Inventions and Innovation Program. The associated cumulative reduction in CO_2 emissions is estimated to be almost 20 million tons. Cumulative savings for avoided fuel purchases total over $1 billion in inflation-adjusted 1999 dollars.

The continued use of the systems could approach cumulative energy savings of 1 quadrillion Btu by the year 2010. Similarly, by 2010 reduced natural gas combustion could eliminate more than 58 million tons of CO_2.



System Economics and Market Potential

Depending on temperature rise, flow rate, and the price of energy, Kemco estimates a 12- to 24-month payback period for its direct-contact water heater based on reduced fuel consumption. Energy savings are enhanced when Kemco's water heater is coupled with Kemco's waste water heat recovery unit. The unit recovers heat from waste water and transfers it to incoming fresh water rather than sending the hot waste water to the sewer.

Many potential marketing opportunities remain for industrial applications of direct-contact hot water heating. The commercial market for direct-contact hot water heaters could potentially reach over 10,000 units by 2002. Kemco is targeting ready-mix concrete batch plants; the United States has over 5,200 such plants.[1] For this application, the direct-contact ready-mix water heater is used to heat water during colder months, allowing plant operations to continue with greater profitability. Other targeted markets include commercial laundry systems, fabric-dyeing facilities, and food processing plants.

NSF Recognition

Kemco was recognized by NSF International as complying with its standard, NSF 05. NSF is an independent, not-for-profit organization that is committed to public health, safety, and protection of the environment. NSF develops national standards; the NSF Mark is recognized for its value in international trade around the world and is respected by regulatory agencies at the local, state, and federal levels.

References

[1] U.S. Census Bureau, 1997 Economic Census, Ready-Mix Concrete Manufacturing.

Inventions and Innovation Program

The Inventions and Innovation Program provides financial assistance for establishing technical performance and conducting early development of innovative ideas and inventions. Ideas that have a significant energy-savings impact and future commercial market potential are chosen for financial support through a competitive solicitation process. Inventions funded by the program have saved enough energy to light 10 million homes per year. In addition, the program offers technical guidance and commercialization support to successful applicants. Ideas that benefit the Industries of the Future, designated by the Office of Industrial Technologies as the most energy-intensive industries in the United States, are especially encouraged.

Project Partners

- Inventions and Innovation Program
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- Lee (Skip) Kemberling
  Owner and CEO
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- Harry E. Wood, Inventor

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